REMARKS

Applicant has amended claims 16 and 20. No new matter has been entered. Additionally, no new issues are raised by such amendments, as the subject matter added to claim 16 was essentially addressed in the previously-considered versions of, e.g., claims 9 and 20. Further, claim 20 has been amended in light of the changes to claim 16.

Claim Rejections Under 35 U.S.C. 102(e)

Claims 16-19 are rejected under 35 U.S.C. 102(e), as being anticipated by Chang et al. (US 2003/0044537A1).

The Examiner, in the Office Action, rejected independent claim 16 using Chang et al. Applicants have amended claim 16. Applicants submit that claim 16, as amended, and those claims depending therefrom are now in condition for allowance.

Amended claim 16 recites in part:

> A method of making a carbon nanotube-based field emission device, comprising steps of:
>
> providing a working plate having a planar surface...
>
> growing a carbon nanotube array on said catalyst layer wherein carbon nanotubes in said array extend from said catalyst layer with flat roots and define different heights with tips;
>
> applying a cathode electrode to said tips of said carbon nanotubes;

separating said carbon nanotubes from said catalyst layer and exposing said flat roots so that the flat roots of the carbon nanotube array are thereby configured for acting as electron emission ends of the carbon nanotube-based field emission device...(Emphasis added.)

Applicants submit that the method as set forth in amended claim 16 is neither taught, disclosed, nor suggested by Chang et al. or any of the other cited references, taken alone or in combination.

Chang et al. discloses a method of making a carbon nanotube field emission display. As shown in FIG. 3A-3H and Paragraphs 14, 26-33 of Chang et al., the method includes the following steps:

step A, a glass substrate 21 is provided;

step B, a first conducting layer 22 is screen printed on the glass substrate 21 as a cold cathode and is sintered;

step C, a carbon nanotube layer 26 is formed on the first conducting layer 22 and a protection layer 27 is formed on the carbon nanotube layer, then the carbon nanotube layer 26 and the protection layer 27 are sintered;

step D, an isolation layer 23 is screen printed on the protection layer 27 and first conducting layer 22;

step E, a second conducting layer 24 is screen printed on the isolation layer 23;

step F, the second conducting layer 24 and the isolation layer 23 are etched to form cavities 231 exposing the protection layer 27 and first

conducting layer 22; and

step G, the second conducting layer 24 and the isolation layer 23 are sintered and the protection layer 27 is removed.

The Examiner states that the protection layer 27 in the method of Chang et al. is the catalyst layer. However, upon closer inspection of Paragraph 29 of Chang et al., the protection layer 27 is actually used to protect the carbon nanotube layer 26 from damages during sintering and sandblasting. Thus, the protection layer 27 has no catalysis during the formation of the carbon nanotube layer 26. Specifically, the carbon nanotube layer 26 is not grown on the protection layer 27. Therefore, the protection layer 27 is not a catalyst layer, within the context of claim 16, as amended.

The carbon nanotube layer 26 of Chang et al. is not a carbon nanotube array grown on the catalyst layer, which is clearly required in claim 16, as amended. Furthermore, there is no specific disclosure or suggestion in the method of Chang et al. that the carbon nanotube layer 26 has exposed flat ends that are a product of the planar surface of the working plate and that are configured for acting as electron emission ends of the carbon nanotube-based field emission display, which has been clearly provided in claim 16, as amended.

Accordingly, Applicants submit that Chang et al. fails to teach or suggest the method, as set forth in amended claim 16. Therefore, amended claim 16 clearly recites novel and unobvious physical subject matter over Chang et al. or any of the other cited references, taken alone or in

combination. Applicants further submit that the novel and unobvious physical features of amended claim 16 produce new and unexpected results over and above Chang et al. or any of the other cited references, taken alone or in combination. The new and unexpected results associated with the claimed method are with a product of the exposed flat roots of the carbon nanotube array. The exposed flat roots of the carbon nanotube array acts as electron emission ends of the carbon nanotube-based field emission device. Thus, such flat ends improve electron emission uniformity and stability of the manufactured device and thus help to overcome the shortcoming of the prior device manufactured by the prior method whose electron emitting surface is neither predictable nor controllable (see Paras. [0003], [0006] and [0027]). Applicants' invention is therefore clearly superior to that of Chang et al. The novel features of Applicants' invention, which give effect to these results, are clearly recited in amended claim 16.

In summary, it is submitted that amended claim 16 is not only novel over Chang et al. under § 102; but also unobvious and patentable over Chang et al., whether taken alone or in combination with the other cited references, under § 103.

Dependent claims 17-19, respectively, incorporate all the subject matter of independent claim 16 and add respective additional subject matter. As detailed above, it is asserted that claim 16 is allowable. Thus, it is submitted that the dependent claims 17-19 are also allowable, and Applicants request that the rejection relating thereto be removed.

Claim Rejections - 35 USC §103

Claims 1, 4, 7-9, 11, 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Han et al. (U.S. 6,515,415 B1) in view of Dai et al. (US Patent 6,232,706 B1).

The Examiner, in the Office action, rejected independent claim 1 using Han et al. '415 in view of Dai et al. '706. Applicants submit that claim 1, and those claims depending therefrom are now in condition for allowance.

Claim 1, recites in part:

> A carbon nanotube-based field emission device comprising:
>
> a cathode electrode; and
>
> ...the carbon nanotube array being aligned perpendicular to the cathode electrode with each given growth end embedded in the cathode electrode and the corresponding root end being outwardly directed and exposed;
>
> ... the root end thereof defines a planar surface with a flatness of less than one micron across the carbon nanotube array. (Emphasis added.)

Applicants submit that the device as set forth in claim 1 is neither taught, disclosed, nor suggested by Han et al. '415, Dai et al. '706, or any of the other cited references, taken alone or in combination.

Han et al. '415 discloses a carbon nanotube field emission display. As shown in FIG. 3 and Col. 3, lines 54-56 of Han et al. '415, the carbon

nanotube field emission display includes a cathode 120, a resistance layer 125 formed on the cathode 120, and carbon nanotubes 121 disposed on the resistance layer 125. The carbon nanotubes 121 are disposed by a screen printing method, a chemical vapor deposition method, an electrophoretic method, or an anodic oxidation alumina sheet cathode method. Detailed, as shown in FIG. 12 through 15C and Col. 5, lines 19-43 of Han et al. '415, when the carbon nanotubes 121 are disposed by the chemical vapor deposition method or the anodic oxidation alumina sheet cathode method, the carbon nanotubes 121 are members of a carbon nanotube array with growth ends thereof exposed and root ends thereof formed on the resistance layer 125, which is opposite to the situation provided in claim 1.

Meanwhile, when the carbon nanotubes 121 are disposed by the screen printing method or the electrophoretic method, the carbon nanotubes 121 are members of a paste/colloidal solution but not members of a carbon nanotube array. Therefore, it is not exactly accurate to say that the carbon nanotubes 121 have growth ends and root ends. Thus, the exposed ends of the carbon nanotubes 121 cannot particularly be interpreted as root ends.

Even if the exposed ends of the carbon nanotubes 121 can be interpreted as root ends, it is clear that the opposite ends of the carbon nanotubes 121 are formed on the resistance layer 125 but not embedded in the cathode 120, which has been clearly required in claim 1.

Furthermore, there is no specific disclosure or suggestion in the carbon nanotube field emission display of Han et al. '415 that the exposed ends of carbon nanotubes 121 thereof defines a planar surface with a flatness of less than one micron, which has been clearly provided in claim 1.

Dai et al. '706 discloses a method of making a field emission device 20. As shown in FIG. 3 and Col. 3, line 46-Col. 4, line 10 of Dai et al. '706, the method includes the following steps:

step A, a silicon substrate 22 is electrochemically etched to form a porous layer 24;

step B, catalytically active iron oxide patterns 26 are formed on the porous layer 24; and

step C, carbon nanotube bundles 28 are grown perpendicular to the substrate 22.

It is clear that the exposed top surface of the carbon nanotube bundles 28 are actually the growth ends thereof, not the root ends thereof. Furthermore, as shown in FIG. 1 and Col. 3, lines 19-32, and Col. 4, lines 11-15 of Dai et al. '706, the top surface of the carbon nanotube bundles can be flat or bowl-shaped, yet no further disclosure or suggestion about either the degree of flatness or the degree of curvature of such array tops is provided by Dai et al. '706. Therefore, there is no specific disclosure or suggestion that, with respect to the carbon nanotube bundles 28 of Dai et al. '706, the exposed ends of the carbon nanotube bundles 28 are root ends and define a planar surface with a flatness of less than one micron, as is clearly set forth in claim 1.

The Examiner attempts to rely on case law (*In re Aller*, 105 USPQ 233) to discover optimum or working ranges and thus to arrive at a particular flatness of less than one micron, as per claim 16, as amended. However, as set forth at MPEP 2144.04, "[if] the applicant has demonstrated the criticality of a specific limitation, it would not be appropriate to rely solely on case law as the rationale to support an obviousness rejection." As set

forth at Paragraph [0006], "[the] flat surface ...results in more uniform and stable electron emissions from the nanotube array." That same paragraph particularly defines "a substantially flat surface" as one having a flatness of "less than 1 micron." As such, Applicant submits that the specific feature of "a flatness of less than one micron" is indeed a critical limitation, with respect to claim 16, and that it is not appropriate to rely solely on case law to support an obviousness rejection over this feature.

Accordingly, Applicants submit that the combination of Han et al. '415 in view of Dai et al. '706 fails to teach or suggest the carbon nanotube-based field emission device as set forth in claim 1. Therefore, claim 1 clearly recites novel and unobvious physical subject matter over Han et al. '415 in view of Dai et al. '706. Applicants submit that the novel and unobvious physical features of claim 1 produce new and unexpected results over and above Han et al. '415, Dai et al. '706 or any of the other cited references, taken alone or in combination. The new and unexpected results related to the claimed carbon nanotube-based field emission device are associated with the embedded growth end and exposed flat root end of the carbon nanotube array. The growth ends of the carbon nanotube array are embedded in the cathode electrode, ensuring a firm retention between the carbon nanotube array and the cathode electrode and thus helping to overcome the shortcoming of the prior device, whose carbon nanotubes are apt to be pulled out of the cathode by the electrical force.

Furthermore, the exposed flat root end of the carbon nanotube array acts as electron emission ends of the carbon nanotube-based field emission device. Thus, this flat end effect improves electron emission uniformity and stability of the manufactured device and thus helps to overcome the

shortcoming of the prior device whose electron emitting surface is neither predictable nor controllable (see Paras. [0003], [0006] and [0027]). Applicants' invention is therefore clearly superior to that of Han et al. '415, Dai et al. '706, or any of the other cited references, taken alone or in combination. The novel features of Applicants' invention, which give effect to these results, are clearly recited in claim 1.

In summary, it is submitted that claim 1 is unobvious and patentable over Han et al. '415, Dai et al. '706, or any of the other cited references under § 103.

Dependent claims 4, 7, and 8, respectively, incorporate all the subject matter of independent claim 1 and add respective additional subject matter. As detailed above, it is asserted that claim 1 is allowable. Thus, it is submitted that the dependent claims 4, 7, and 8 are also allowable, and Applicants request that the rejection relating thereto be removed.

The Examiner, in the Office action, rejected independent claim 9 using Han et al. '415 in view of Dai et al. '706. Applicants submit that claim 9 and those claims depending therefrom are now in condition for allowance.

Claim 9 recites in part:

A carbon nanotube-based field emission device comprising:

...a cathode electrode formed on and covering the growth end of the carbon nanotube array;

wherein the root end defines a planar surface which is exposed

outwardly and acts as an emitter, a flatness of the planar surface of the root end of the carbon nanotube array is less than 1 micron, and the growth end is embedded into the cathode electrode. (Emphasis added.)

Applicants submit that the device as set forth in claim 9 is neither taught, disclosed, nor suggested by Han et al. '415, Dai et al. '706, or any of the other cited references, taken alone or in combination.

For reasons similar to those asserted above in relation to the rejection of claim 1 under 35 U.S.C. § 103 on Han et al. '415 in view of Dai et al. '706, Applicants submit that subject matter as set forth in claim 9 is neither taught, disclosed, nor suggest by Han et al. '415, Dai et al. '706, or any of the other cited references, taken alone or in combination.

Moreover, Applicants submit that the novel and unobvious physical features of claim 9 produces new and unexpected results over and above Han et al. '415 or Dai et al. '706, or any of the other cited references, taken alone or in combination. Applicants' invention is therefore clearly superior to that of any one of Han et al. '415 or Dai et al. '706, or any proposed combination thereof. The novel features of Applicants' invention, which give effect to these results, are clearly recited in claim 9.

Therefore, claim 9 is unobvious and patentable over Han et al. '415, Dai et al. '706 or any of the other cited references under § 103.

Dependent claims 11, 14, and 15 incorporate all the subject matter of independent claim 9 and add respective additional subject matter. As detailed above, it is asserted that claim 9 is allowable. Thus, it is submitted that the dependent claims 11, 14, and 15 are also allowable, and Applicants request that the rejection relating thereto be removed.

Claims 3, 5, 6, 12 and 13 are rejected under 35 U.S.C. 103(a) as being anticipated over Han et al. (U.S. 6,515,415B1) in view of Nakamoto (U.S. 6,097,138B1).

Dependent claims 3, 5, and 6 incorporate all the subject matter of independent claim 1, respectively, and add respective additional subject matter. As detailed above, it is asserted that claim 1 is allowable. Thus, it is submitted that the dependent claims 3, 5, and 6 are also allowable, and Applicants request that the rejection relating thereto be removed.

Dependent claims 12 and 13 incorporate all the subject matter of independent claim 9, respectively, and add respective additional subject matter. As detailed above, it is asserted that claim 9 is allowable. Thus, it is submitted that the dependent claims 12 and 13 are also allowable, and Applicants request that the rejection relating thereto be removed.

Claim 20 is rejected under 35 U.S.C. 103(a) as being anticipated over Chang et al. (US 2003/0044537A1).

Dependent claim 20 incorporates all the subject matter of independent claim 16 and adds respective additional subject matter. As detailed above, it is asserted that claim 16 is allowable. Thus, it is submitted that the

dependent claim 20 is also allowable, and Applicants request that the rejection relating thereto be removed.

Respectfully submitted,
Liang Liu

By Jeffrey T. Knapp

Jeffrey T. Knapp
Registration No.: 45,384
Foxconn International, Inc.
1650 Memorex Drive
Santa Clara, CA 95050
Tel. No.: 714/626-1229